

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
Before the Board of Patent Appeals and Interferences

In re Patent Application of

Atty Dkt. SCS-124-1158

C# M#

Confirmation No. 5737

PHILLIPS et al.

TC/A.U.: 2814

Serial No. 10/577,938

Examiner: H. Weiss

Filed: May 3, 2006

Date: November 3, 2008

Title: STRAINED SEMICONDUCTOR DEVICES



Mail Stop Appeal Brief - Patents

Commissioner for Patents

P.O. Box 1450

Alexandria, VA 22313-1450

Sir:

☐ **Correspondence Address Indication Form Attached.**

☐ **NOTICE OF APPEAL**

Applicant hereby **appeals** to the Board of Patent Appeals and Interferences

from the last decision of the Examiner twice/finally rejecting
applicant's claim(s).

\$540.00 (1401)/\$270.00 (2401) \$

☐ An appeal **BRIEF** is attached in the pending appeal of the
above-identified application

\$540.00 (1402)/\$270.00 (2402) \$

☐ Credit for fees paid in prior appeal without decision on merits

-\$ ()

☒ A reply brief is attached.

(no fee)

☐ Petition is hereby made to extend the current due date so as to cover the filing date of this
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One Month Extension \$130.00 (1251)/\$65.00 (2251)

Two Month Extensions \$490.00 (1252)/\$245.00 (2252)

Three Month Extensions \$1110.00 (1253)/\$555.00 (2253)

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☐ "Small entity" statement attached.

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TOTAL FEE ENCLOSED \$ 0.00

☐ **CREDIT CARD PAYMENT FORM ATTACHED.**

Any future submission requiring an extension of time is hereby stated to include a petition for such time extension.
The Commissioner is hereby authorized to charge any deficiency, or credit any overpayment, in the fee(s) filed, or
asserted to be filed, or which should have been filed herewith (or with any paper hereafter filed in this application by this
firm) to our **Account No. 14-1140**.

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By Atty: Stanley C. Spooner, Reg. No. 27,393

Signature: 



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REPLY BRIEF

This Reply Brief is responsive to the Examiner's Answer mailed September 2, 2008 responding to various errors and new points of argument made by the Examiner with respect to Appellants' Appeal Brief.

Inasmuch as the primary arguments presented in the Examiner's Answer appear to be identical to the rejections and arguments presented in the second non-final Official Action mailed November 27, 2007, Appellants rely upon the detailed response contained in the Appeal Brief. However, beginning on page 3 of the Examiner's Answer, the Examiner includes a "Response to Argument" which purportedly responds to the specific errors raised in Appellants' Appeal Brief and will be responded to in detail. Inasmuch as

the Examiner utilizes the headings of the Argument portion of the Appeal Brief, Appellants will adopt similar headings for consistency's sake.

A. The rejection of claims 9 and 16 under 35 USC §112 (first paragraph) is not supported by the facts – the Examiner fails to appreciate that the alleged missing written description is disclosed in Appellants' specification, is known by those of ordinary skill and is present in previously published prior art

The Examiner's acknowledgment that Appellants' arguments against the 35 USC §112 (first paragraph) rejection of claims 9 and 16 "are persuasive" and that "this rejection has been dropped by the Examiner" is very much appreciated.

As noted by the Examiner, the withdrawal of the §112 rejection leaves "only the rejections under 35 USC 102(b)" to be considered.

B. The Examiner fails to establish where Phillips '674 contains any disclosure of "at least one narrow bandgap region under compressive mechanical strain" as required by independent claims 1 and 16

When challenged in the Appeal Brief to identify where the cited prior art reference of Phillips '674 contains any disclosure of the claimed "at least one narrow bandgap region under compressive mechanical strain," the Examiner again confirms his sole reliance is upon the Phillips '674 patent at page 10, lines 12-14 and 21 and 22. However, as noted in the Appeal Brief, there is no disclosure of any "mechanical" strain or any "compressive" strain disclosed in the Phillips '674 patent.

1. No teaching of a "narrow bandgap region" in the cited Phillips '674 patent that is either "doped p-type material" or "a material containing an excess of holes."

The first of the fatal errors in the Examiner's rejection is the failure to recognize that Phillips '674 specifically teaches away from the independent claim requirement that the transistor have "at least one narrow bandgap region . . . comprising at least one of a doped p-type material and a material containing an excess of holes.

For example, the cited portion of Phillips '674, i.e., page 10, lines 12-14 and lines 21 and 22, all relate to the disclosure in Figure 7. But the Examiner erroneously states that "[t]he narrow band-gap, p-doped structure in the device of Phillips '674 (region 22 as depicted in Figure 4) is identical to the instant invention . . . in both material and thickness. Yet, Phillips, at page 10, line 17 specifically requires that the "primary conduction channel 27 (22) is of **undoped indium antimonide**" (emphasis added). Channel 22 in figure 7 is the same as channel 22 in Figure 4 (which does not describe the channel as being doped). Accordingly, even if there were some of the required compressive strain, the purported narrow band gap "region 22" in Phillips '674 does not meet the requirements of independent claims 1 and 16.

2. No teaching of "compressive," "mechanical" strain in the "narrow bandgap region" in the cited Phillips '674 patent

While the Examiner notes the specification teaching discussed in the Appeal Brief, i.e., "as discussed in the present specification on pages 4-5 variations in the layer thicknesses as well as the differing lattice contents of the material **can** be combined to provide different types of mechanical strain (both compressive and tensile)," he apparently fails to identify any recognition in Phillips '647 that "compressive mechanical strain" would have the disclosed beneficial effect (emphasis in the original).

Attempting to account for this defect, the Examiner on page 4 of the Answer suggests that “**compressive** strain is an inherent product of this layered structure,” but the Examiner provides no reasoning or evidentiary support for this conclusion (emphasis added). The quoted portion of Appellants’ specification merely discloses that in certain circumstances the presence of the $Al_xIn_{1-x}Sb$ can introduce compressive strain into the quantum well or base region, respectively.

However, the cited portion of Phillips ‘674, i.e., page 10, lines 12-14 and lines 21 and 22, all relate to the disclosure in Figure 7 which includes the statement that the $Al_xIn_{1-x}Sb$ layer and the surrounding layers 23 “provides a structure that is **strain balanced**” (emphasis added). This is taken to mean that a compressive strain in one layer matches a tensile strain in the adjacent layer. This does not say that the $InAlSb$ layer places the narrow bandgap region of the $InSb$ layer in compression.

Thus, neither Appellants’ specification nor Phillips ‘674 teaches that “compressive strain is an inherent product of this layered structure” as contended by the Examiner. Strain balance does not disclose “compressive mechanical strain” as required by the independent claims.

3. The Examiner misapplies the Manual of Patent Examining Procedure (MPEP) Section 2112(V)

In the first full paragraph on page 5 of the Examiner’s Answer, the Examiner relies upon MPEP Section 2112(V) and Sections 2112.01(I and II) as support for his erroneous conclusions. These sections establish that the Examiner’s burden of proving anticipation is met **only** when the examiner “presents evidence or reasoning tending to

show inherency.” Furthermore, only after the examiner has presented “evidence or reasoning tending to show inherency” that the burden shifts to the applicant.

In the present case, as noted in Section B of the Appeal Brief, the Examiner has not met his burden of providing either “evidence or reasoning” tending to show inherency. Although not stated, it is possible that the Examiner contends that Appellants’ specification paragraph bridging pages 3 and 4 is such “evidence.” However, this portion of the specification merely states that in the case where FETs and bipolar transistors are based on InSb, the presence of an $\text{Al}_x\text{In}_{1-x}\text{Sb}$ layer “having a significantly lower lattice constant will introduce a strongly compressive strain . . .” (emphasis added). The Examiner has not indicated how or where Phillips ‘674 teaches the necessary “significantly lower lattice constant” which is necessary to “introduce a strongly compressive strain.” Instead, the Examiner apparently ignores this requirement and the fact that the lattice constants in Phillips ‘674 specifically teaches that it “provides a structure that is strain balanced.”

Accordingly, the Examiner has failed to meet his burden of presenting “evidence or reasoning tending to show inherency” and thus does not shift to the applicant to show an unobvious difference.

The Examiner additionally relies upon MPEP Section 2112.01(I and II) in arguing that the structure recited in the reference “is substantially identical to that of the claims.” In fact, Appellants’ claims specify a “p-doped material” or “a material containing an excess of holes” which comprises the “narrow bandgap region” which is under “compressive mechanical strain” and there is no disclosure in Phillips ‘674 teaching any

narrow bandgap region under “compressive mechanical strain” and, in fact, the Examiner ignores the teaching in Phillips ‘674 which suggests that the structure be “strain balanced.”

The Examiner also relies upon subsection II by suggesting that “if the composition is physically the same, it must have the same properties.” However, the Examiner does not provide any reasoning or evidence to suggest that the structures in Phillips ‘674 and the instant invention are **identical** structures. Where is there any teaching that the compressively strained narrow bandgap region, if it exists at all in Phillips, is the claimed region with “doped p-type material” or “a material containing an excess of holes” as required by the claims 1 & 16. While the Examiner is correct in noting that the elements contained in the differing layers are the same elements, it doesn’t indicated the existence of any p-type material or excess hole material.

While Appellants’ independent claim does not specify a particular concentration of the ingredients for the various layers, it does teach that those concentrations must be such that it creates the claimed “at least one narrow bandgap region under compressive mechanical strain.” The Examiner has not shown that Phillips ‘674 teaches any combination of elements with the necessary concentrations which provide this compressive mechanical strain. In fact, as noted above, Phillips ‘674 discloses concentrations which provide that the structure is “strain balanced” without any allegation of being under “compressive mechanical strain.”

In summary, the MPEP’s elaboration of how a prior art reference can support a rejection under §102 upon which the Examiner relies does not support the Examiner’s

argument. The Examiner has not met the first step of Section 2112(V) by showing that a prior art teaching is “substantially identical” (since Phillips ‘647 has no doping or excess holes discussion) **and** that the Examiner provides “evidence or reasoning tending to show inherency” (no disclosure of any “compressive” strain). Without meeting **both** of these requirements, the burden does not shift from the Examiner to the applicant to show an obvious difference.

Accordingly, and in view of the above, the Examiner’s reliance upon the MPEP definitions is misplaced because the Examiner has not met any of the threshold requirements for establishing “inherency.”

4. Appellant meets the burden of showing an unobvious difference

Even if the Examiner had met the burden of showing “substantially identical” **and** “evidence or reasoning tending to show inherency,” this merely shifts the burden to the applicant “to show an unobvious difference.” Again, as noted above, Appellants’ claims specify the direct opposite of the combination of elements disclosed in Phillips ‘674, i.e., Appellants’ interrelationship among layers in the transistor to provide “at least one narrow bandgap region under compressive mechanical strain” with “at least one of a doped p-type material and a material containing an excess of holes” and Phillips ‘674 specifically teaches the opposite, i.e., “a structure that is strain balanced” which is “undoped.”

This opposite teaching in Phillips '674 clearly establishes that the presently claimed invention is unobviously different from the disclosure in Phillips '674 and therefore Appellants have rebutted the Examiner's conclusion.

5. Apart from the materials which result in the claimed “compressive mechanical strain,” the Examiner fails to appreciate that Appellants' claim is to a transistor including “at least one narrow bandgap region” which is comprised of “at least one of a doped p-type material and a material containing an excess of holes”

Those persons of ordinary skill in the art reviewing Figure 4 of the Phillips '674 patent will understand that the only narrow bandgap region disclosed in Phillips '674 is region 22 and that that region is undoped. How or why does the Examiner believe this discloses the claimed narrow bandgap region which is comprised of one of “a doped p-type material” and “a material containing an excess of holes?”

Phillips '674 at page 2, line 9, stipulates that the material of layer 5 is preferably undoped or has little doping. Additionally, the general discussion of MODFETs on page 1, lines 17-22, advises that the material of the conduction channel is commonly “substantially undoped or only very lightly doped so as to maximize the carrier mobility, velocity and mean free path.”

In view of these specific teachings of a preference for undoped or only slightly doped materials, how or where does the Examiner contend that Phillips '674 teaches the claimed “narrow bandgap region” which is either a “doped p-type material and/or an “excess of holes” material sufficient to provide any “compressive mechanical strain?”

The Examiner simply ignores this requirement of Appellants' independent claims.

The Examiner does not identify any disclosure in Phillips '674 which teaches all of the claimed aspects of the claimed transistor. Where and how are these claimed features taught in the Phillips '674 reference? They are simply not taught and therefore Phillips '674 cannot possibly anticipate the subject matter of the independent claims and any further rejection under 35 USC §102 is respectfully traversed.

C. The Examiner fails to even allege that Phillips '337 contains any suggestion of "at least one narrow bandgap region under compressive mechanical strain"

In response to the Appeal Brief pointing out that the Examiner's second non-final Official Action contains no disclosure or allegation that the Phillips '337 reference has any teaching of a bandgap region which is "under compressive mechanical strain," the Examiner repeats the Appeal Brief allegation (page 6, lines 1-3). However, the Examiner does not dispute this allegation and merely references Figure 1 of Phillips '337 which has a base layer of InSb in contact with two layers 20 and 26 of InAlSb.

However, the Examiner fails to appreciate that in Figure 1, layers 20 and 26 purportedly of the InAlSb material do not even sandwich the base layer 18 as in the Phillips '674 patent or as disclosed in Appellants' current specification. Thus, Phillips '337 is even more removed from the presently claimed invention than is Phillips '674. In fact, given the thicknesses of the various layers described on page 3, the only strain that will occur is tensile straining of the layers 20 and 26, and not the purported narrow bandgap region 18 as suggested by the Examiner. This is because the total thickness of the various InSb layers making up the purported "narrow bandgap region is 501.6microns

(substrate 12 is 500microns thick, layer 14 is 1micron, layer 16 is .5 microns, and layer 18 is 0.12 microns) and the InAlSb layer is only .03 microns (30 nm is equal to .03 microns). Thus the InSb layers (12, 14, 16 & 18) which all have the same lattice constant are over 16,000 times thicker than the InAlSb layer with a different lattice constant. To the extent that anything is strained, it will be the InAlSb layer and it will be strained in tension and the InSb layers will not be significantly strained at all.

Unlike Phillips '674, which had no doping of the narrow bandgap region, Phillips '337 may have doping, but no compressive straining.

The Examiner appears to be misapplying the previously discussed portions of the MPEP and concludes that the mere disclosure in the prior art of contact between InSb and InAlSb somehow automatically imparts a compressive strain. As noted in Appellants' specification and as discussed above, this arrangement would not necessarily provide a "narrow bandgap region under compressive mechanical strain." As noted in Appellants' specification, the impurity concentration in the InAlSb layer must have a "significantly lower lattice constant" in order to introduce the compressive mechanical strain of Appellants' independent claim. Thus, for all the reasons discussed above, the disclosure in Phillips '337 does not inherently disclose the subject matter of Appellants' independent claims.

Importantly, the Examiner actually admits that he has failed to meet his burden of going forward with either reasoning or evidence ("[w]hile this is not explicitly stated in the rejection, it is implied in view of the previous analysis and statements" Examiner's Answer page 6, end of section C). In other words, what the Examiner is saying is that he

is admitting that there is no disclosure of how or why Phillips '337 teaches a narrow bandgap material under compressive mechanical strain, but that this information is somehow "implied in view of the previous analysis and statements."

Thus, one of ordinary skill in the art would somehow infer from somewhere in the Examiner's previous Official Actions that there is an "analysis and statements" that somehow implies that the Phillips '337 reference "inherently" discloses a doping configuration which provides the claimed "compressive mechanical strain." The Examiner's speculative supposition is simply not the test of anticipation under 35 USC §102. If the Examiner wishes to argue that this alleged "inherency" justified by the "implied" consideration of the somewhat nebulous "previous analysis and statements," such a rejection is, at best, founded under "obviousness" and not "anticipation."

Perhaps the most telling observation is that the Examiner has failed to disclose any "narrow bandgap region" in Phillips '337 because the two layers 20 and 26 are on the same side of the base 18. How is a "narrow bandgap region" even created with this construction? Because the layers 20 and 26 are on the same side of the base layer, to the extent they could provide even the slightest compression at the interface between layers 18 and 20 or 18 and 26, they fail to disclose that the claimed "narrow bandgap region" which must be "under compressive mechanical strain." The Examiner has not contended that the narrow bandgap region exists only at the interface of the InSb and InAlSb layers.

For all of the above reasons, Phillips '337 does not support an anticipation rejection of Appellants' independent claims.

D. There is no basis for any future obviousness rejection over Phillips ‘674 and/or Phillips ‘337

While the Examiner argues that Appellants’ comments regarding obligations to assign to the same party, i.e., assignee of the current application, QinetiQ Limited, under the provisions of 35 USC §103(c) should not be considered, Appellants agree. The only rejections of record are based upon “anticipation” and these rejections have been clearly rebutted by both the Appeal Brief and the above discussion in this Reply Brief.

However, because the Board is free to institute on its own “obviousness” rejections if warranted (in place of the Examiner’s defective “anticipation” rejections) and because the Examiner admits that the support for his rejection is “not explicitly stated in the rejection” and therefore is at best, only implied. The Board may consider an obviousness basis for rejection, especially since the Examiner has not set forth a properly reasoned or evidentiary analysis of his inherency argument. Should the Board reject the Examiner’s anticipation rejections and consider an obviousness rejection, Appellants’ inclusion of this rebuttal argument is merely an aid to the Board.

Accordingly, the argument in Section D is believed appropriate and raises the issue of the fact that one reference, Phillips ‘337, contains at best tensile strain and no disclosure of “compressive mechanical strain” and the other reference, Phillips ‘674, teaches away from a doped “narrow band gap region” with compressive mechanical strain (in suggesting “strain balance”). As a result, there is simply no case for an obviousness rejection based on either of these references by themselves or in combination.

E. The Examiner fails to establish that all elements in claims 1-9, 12-14 and 16 are disclosed in Phillips '674 and F. The Examiner fails to establish that all elements in claims 1, 10 and 11 are disclosed in Phillips '337

In the Appeal Brief Sections E and F, Appellants have summarized where and how the anticipation rejections based upon Phillips '674 and Phillips '337 fail to disclose each and every claim element and each and every claimed interrelationship as required in order to meet the Examiner's burden of setting out a *prima facie* case of anticipation.

The Examiner relies upon the arguments in the second non-final Official Action mailed November 29, 2007 and does not provide any additional reasoning or evidence in support of his inherency conclusions. As a result, as discussed in the Appeal Brief with respect to the Phillips '674 and Phillips '337 references, the Examiner has not established any case of anticipation and the Examiner's conclusion to the contrary is respectfully traversed.

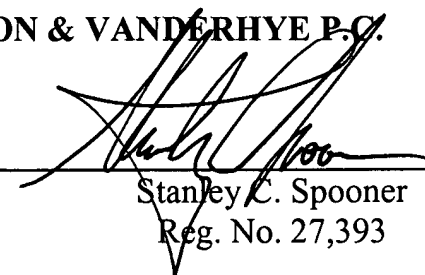
As a result of the above, there is simply no support for the rejections of Appellants' independent claims or claims dependent thereon under 35 USC §102. Thus, and in view of the above, the remaining rejection of claims 1-14 and 16 under 35 USC §102 is clearly in error and reversal thereof by this Honorable Board is respectfully requested.

PHILLIPS et al.
Serial No. 10/577,938

Respectfully submitted,

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